Radioactivity in the Risø District January-June 2010

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Publication date:
2010

Document Version
Publisher's PDF, also known as Version of record

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Risø-R-Report

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Risø-R-1756(EN)
December 2010

Risø DTU
National Laboratory for Sustainable Energy

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Title: Radioactivity in the Risø District January-June 2010
Division: Radiation Research

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Abstract (max. 2000 char.): The environmental surveillance of the Risø environment was continued in January - June 2010. The mean concentrations in air were: 0.99±1.11 μBq m^{-3} of ^{137}Cs, 4.56±2.71 mBq m^{-3} of ^{7}Be and 0.49±0.57 mBq m^{-3} of ^{210}Pb (±1 S.D.; N = 26). The depositions by precipitation at Risø in the first half of 2010 were: 0.095 Bq m^{-2} of ^{137}Cs, 521 Bq m^{-2} of ^{7}Be, 48.2 Bq m^{-2} of ^{210}Pb and < 0.5 kBq m^{-2} of ^{3}H. The average background dose rate (TLD) at Risø (Zone I) was 106 nSv h^{-1} compared with 91 ± 4 nSv h^{-1} (±1 S.D.; N = 4) in the four zones around Risø.

ISSN 0106-2840
ISBN 978-87-550-3863-9

Contract no.:

Group's own reg. no.:
1400103-07

Sponsorship:

Cover :

Pages: 24
Tables: 14
References:

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Table 1. Radionuclides in ground level air collected at Risø (cf. Figs. 1, 1.1 and 1.2), January - June 2010. (Unit: μBq m^{-3})

Date		^{7}Be	^{137}Cs	^{210}Pb
28-Dec-09 –	04-Jan-10	2923	0.472	239
04-Jan-10 –	11-Jan-10	4289	1.193	759
11-Jan-10* –	18-Jan-10	9364	1.838	872
18-Jan-10* –	26-Jan-10	14080	4.618	1550
26-Jan-10* –	01-Feb-10	6610	2.287	684
01-Feb-10* –	08-Feb-10	7738	3.669	2293
08-Feb-10* –	15-Feb-10	5422	2.191	1525
15-Feb-10* –	22-Feb-10	3387	1.238	1262
22-Feb-10 –	01-Mar-10	3011	0.796	383
01-Mar-10 –	08-Mar-10	4779	0.864	330
08-Mar-10 –	15-Mar-10	4413	0.752	164
15-Mar-10 –	22-Mar-10	8337	1.241	468
22-Mar-10 –	29-Mar-10	3657	0.416	205
29-Mar-10 –	06-Apr-10	2344	0.263	103
06-Apr-10 –	13-Apr-10	2401	0.434	202
13-Apr-10 –	19-Apr-10	2615	0.565	171
19-Apr-10 –	26-Apr-10	3703	0.353	155
26-Apr-10 –	03-May-10	3707	0.431	188
03-May-10 –	10-May-10	3858	0.292	169
10-May-10 –	17-May-10	3820	0.295	159
17-May-10 –	25-May-10	2470	0.361	248
25-May-10 –	31-May-10	2105	0.240	87
31-May-10 –	07-Jun-10	3505	0.299	157
07-Jun-10 –	14-Jun-10	4547	0.150	185
14-Jun-10 –	22-Jun-10	2626	0.177	98
22-Jun-10 –	28-Jun-10	2934	0.316	157
Mean		4563	0.990	493
SD		2714	1.114	567

* Uncertain air volume determination due to frost

Table 2.1. Radionuclides in precipitation in the 10 m^2 rain collector at Risø (cf. Fig. 1), January - June 2010. (Unit: Bq m^{-3})

Month	^{7}Be	^{137}Cs	^{210}Pb
January	2092	0.313	308
February	2509	0.285	221
March	1830	0.124	137
April	1805	0.331	69
May	821	0.126	38
June	5359	1.339	561

Table 2.2. Radionuclides in precipitation in the 10 m^2 rain collector at Risø (cf. Fig. 1), January - June 2010. (Unit: Bq m^{-2})

Month	Precipitation (m)	^{7}Be	^{137}Cs	^{210}Pb
January	0.016	34.5	0.0052	5.1
February	0.023	56.5	0.0064	5.0
March	0.054	99.0	0.0067	7.4
April	0.012	20.9	0.0038	0.8
May	0.052	43.1	0.0066	2.0
June	0.049	267.0	0.0667	27.9
Sum	0.206	521.0	0.0954	48.2

Table 2.3. Tritium in precipitation collected at Risø (cf. Figs. 1, 2.3.1 and 2.3.2). January - June 2010. (Unit: kBq m^{-3})

Month	1 m^2 rain collector*	10 m^2 rain collector*
January	< 2.0	< 2.0
February	< 2.0	< 2.0
March	< 2.0	< 2.0
April	< 2.0	< 2.0
May	< 2.0	2.5
June	< 2.0	2.7
Double determinations*.		

Table 2.4. Tritium in precipitation collected at Risø (cf. Fig. 1). January - June 2010. (Unit: kBq m^{-2})

Month	Precipitation (m)	1 m^2 rain collector	10 m^2 rain collector
January	0.016	< 0.032	< 0.032
February	0.023	< 0.046	< 0.046
March	0.054	< 0.108	< 0.108
April	0.012	< 0.024	< 0.024
May	0.052	< 0.104	0.130
June	0.049	< 0.098	0.132
Sum	0.206	< 0.412	< 0.472

Table 3.1. Radionuclides in sediment samples collected at Bolund in Roskilde Fjord.(cf. Fig. 3.1) January - June 2010. (Unit: Bq kg^{-1} dry)

No samples in this period

Table 4.1. Radionuclides in seawater collected in Roskilde Fjord (cf. Fig. 4.1) January - June 2010. (Unit: Bq m^{-3})

No samples in this period

Table 4.2. Tritium in seawater collected in Roskilde Fjord (Risø pier) (cf. Fig. 4.2) January - June 2010.

Month	kBq m^{-3}
January	< 2.0 *
February	< 2.0 *
March	< 2.0 *
April	2.3 *
May	< 2.0 *
June	< 2.0 *

* Double determinations

Table 5.1. Radionuclides in grass (snow) collected at Risø (near the Waste Treatment Station (cf. Fig. 1)), January - June 2010. (**Measured on bulked ash samples)*

Week no. or month	Date	K (g kg^{-1} fresh)	^{137}Cs (Bq kg^{-1} fresh)	^{137}Cs (Bq m^{-2})
1	4 January*	<0.9	<0.3	
2	11 January*	-	<0.3	
3	18 January*	<0.2	<0.4	
4	25 January*	<0.2	<0.3	
5	1 February*	<1.6	<0.4	
6	8 February*	<0.2	<0.3	
7	15 February*	<0.1	<0.3	
8	22 February*	<0.2	<0.4	
9	1 March*	<0.1	<0.2	
10	8 March*	<0.2	<0.3	
11	15 March	4.2	<0.5	
12	22 March	4.1	<1.4	
13	29 March	4.1	<1.6	
14	6 April	5.2	<1.1	
15	12 April	4.6	<0.7	
16	19 April	6.8	<1.2	
17	26 April	7.3	<0.6	
18	3 May	4.8	<0.5	
19	10 May	5.0	<0.7	
20	17 May	3.5	<0.5	
21	25 May	4.5	<0.4	
22	31 May	4.2	<0.4	
23	7 June	4.2	<0.5	
24	14 June	4.4	<0.5	
25	21 June	4.8	<0.5	
26	28 June	4.7	<0.4	
**January		1.3	-	-
**February		-	-	-
**March		4.2	0.197	0.021
**April		5.9	0.238	0.037
**May		4.9	0.130	0.050
**June		4.8	0.040	0.037

Table 5.2. Radionuclides in Fucus vesiculosus collected at Bolund in Roskilde Fjord. January - June 2010. (Unit: Bq kg^{-1} dry)

No samples in this period

Table 7.1. Waste water collected at Risø (cf. Fig. 1), January - June 2010.

Week number	eqv. mg KCl l^{-1}	^{137}Cs (Bq m^{-3})	^{131}I (Bq m^{-3})	^{226}Ra (Bq m^{-3})
1	32	<128	<136	<243
2	58	<113	<118	<230
3	63	<107	<115	<218
4	77	<112	<117	<221
5	79	<113	<124	<229
6	90	<110	<117	<216
7	96	<123	<119	<224
8	89	<113	<120	<229
9	74	<115	<120	484
10	78	<132	<138	<249
11	126	185.7	<127	<223
12	75	<123	<120	<222
13	103	<112	<117	<219
14	51	<124	<120	<242
15	57	<112	<117	<221
16	66	<113	<118	<220
17	95	<125	<112	<215
18	49	<126	<123	<229
19	93	<114	<120	<220
20	75	<135	<141	<261
21	60	<116	<121	<226
22	70	<114	<117	<224
23	81	<128	<129	<237
24	49	<109	<112	<213
25	72	<112	<119	<217
26	129	<113	<120	<226
Mean	76.4			
SD	22.6			

Table 8.1. Background dose rates around the border of Risø (cf. Fig. 8.1) measured with thermoluminescence dosimeters (TLD) in the period November 2009 – April 2010. (Results are normalized to nSv h^{-1})

Location	nSv h^{-1}
1	95
2	87
3	78
4	86
5	94
6	105
Mean	91

Table 8.2. Background dose rates around Risø (cf. Fig. 8.2 and Fig. 1) measured with thermoluminescence dosimeters (TLD) in the period November 2009 – April 2010. (Results are normalized to nSv h^{-1})

Risø zone	Location	nSv h^{-1}
I	1	76
I	2	92
I	3	169
I	4	96
I	5	98
Mean		106
II	P1	95
II	P2	89
II	P3	76
II	P4	104
Mean		91
III	P1	83
III	P2	92
III	P3	86
Mean		87
IV	P1	76
IV	P2	83
IV	P3	92
IV	P4	94
IV	P5	96
IV	P6	85
IV	P7	114
Mean		91
V	P1	101
V	P2	94
V	P3	115
V	P4	80
V	P5	103
V	P6	81
V	P7	86
V	P8	110
V	P9	96
V	P10	104
Mean		97

Table 8.3. Terrestrial dose rates at the Risø zones (cf. Fig. 8.2 and Fig. 1) January - June 2010. Measured with a NaI(Tl) detector. (Unit: nSv h^{-1})

Risø zone	Location	January	October
I	P1	33	34
I	P2	43	43
I	P3	420	377
I	P4	39	40
I	P5	40	40
Mean		115	107
II	P1	43	41
II	P2	38	37
II	P3	36	39
II	P4	39	37
Mean		39	39
III	P1		41
III	P2		40
III	P3		38
Mean			40
IV	P1		35
IV	P2		42
IV	P3		38
IV	P4		40
IV	P5		36
IV	P6		40
IV	P7		42
Mean			39
V	P1		35
V	P2		44
V	P3		48
V	P4		42
V	P5		45
V	P6		40
V	P7		34
V	P7a		37
V	P8		38
V	P9		47
V	P10		34
Mean			40

Fig. 1. Locations for measurements of gamma-background radiation Zone I and II (cf. Tables 8.2 and 8.3)

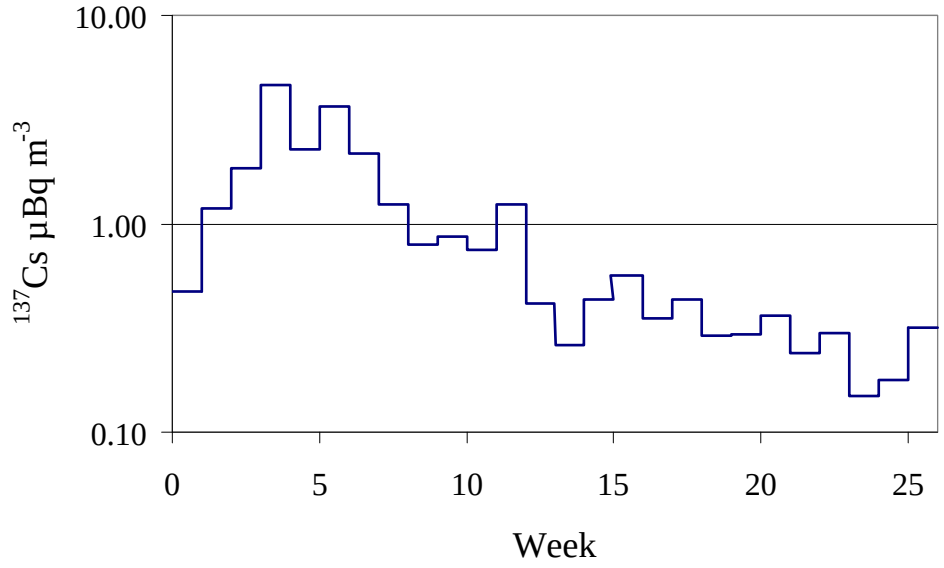

Fig. 1.1. Caesium-137 in ground level air collected at Risø in January-June 2010. (Unit: µBq m^{-3})

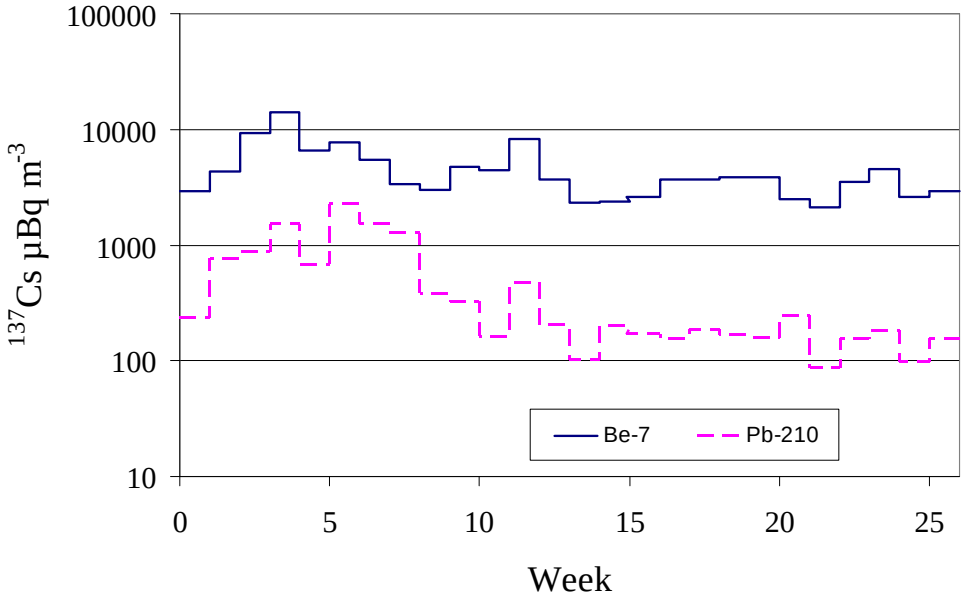

Fig. 1.2. Beryllium-7 and lead-210 in ground level air collected at Risø in January- June 2010. (Unit: µBq m^{-3})

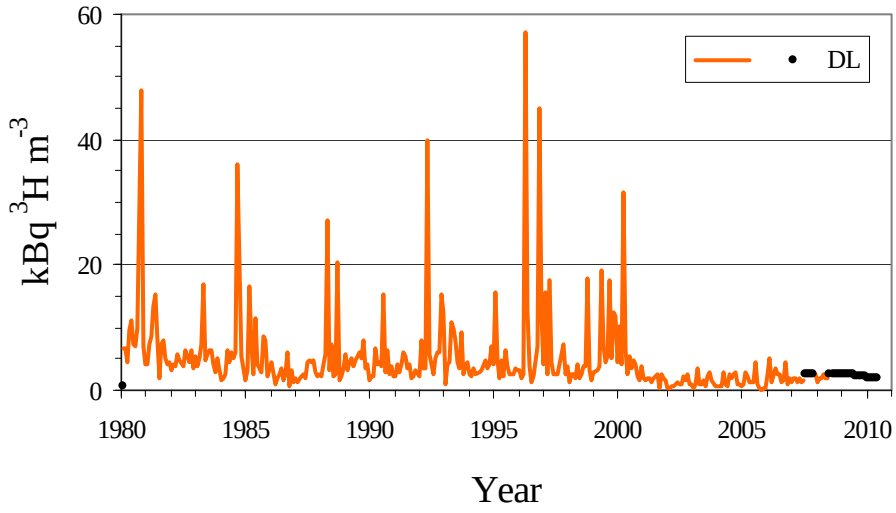

Fig. 2.3.1. Tritium in precipitation collected at Risø (1 m^2 rain collector) 1980 - 2010. (Unit: kBq m^{-3}; DL = detection limit)

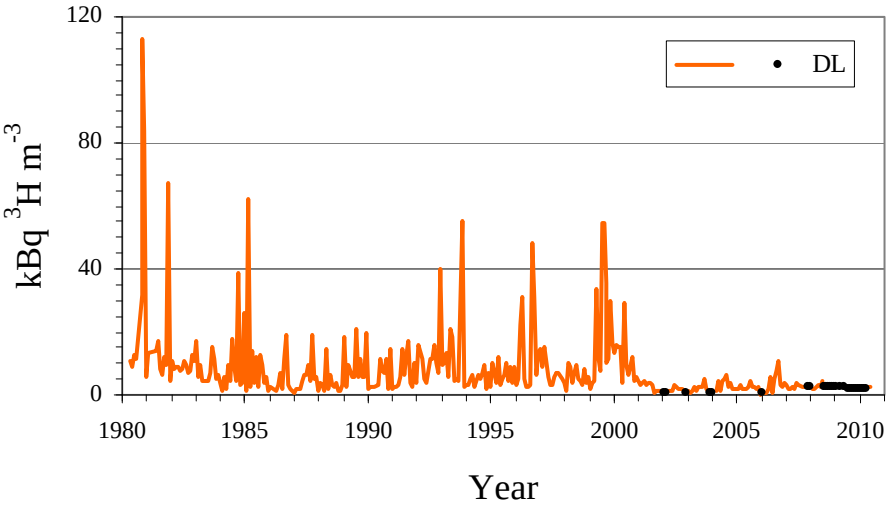

Fig. 2.3.2. Tritium in precipitation collected at Risø (10 m^2 rain collector) 1980 - 2010. (Unit: kBq m^{-3}; DL = detection limit)

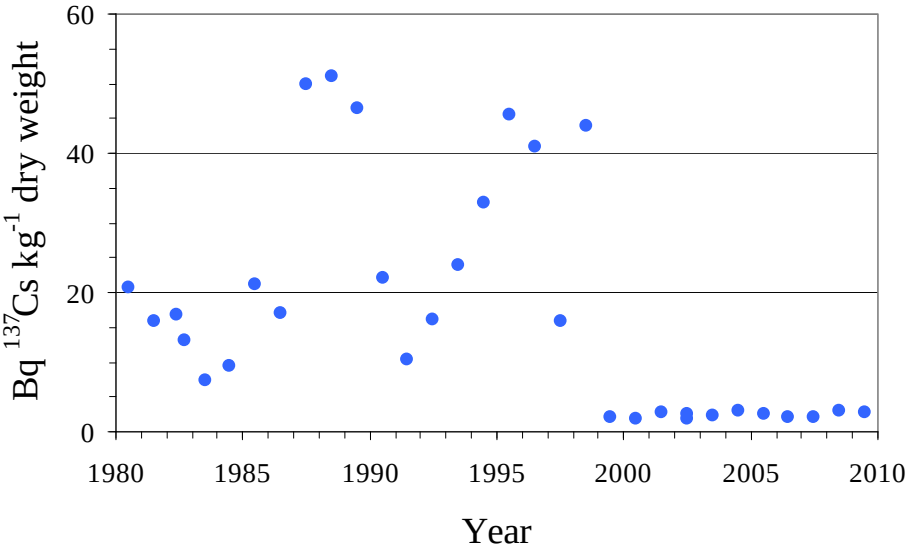

Fig. 3.1. Caesium–137 in sediment samples collected at Bolund in Roskilde Fjord. 1980 – 2009. (Unit: Bq kg^{-1} dry matter)

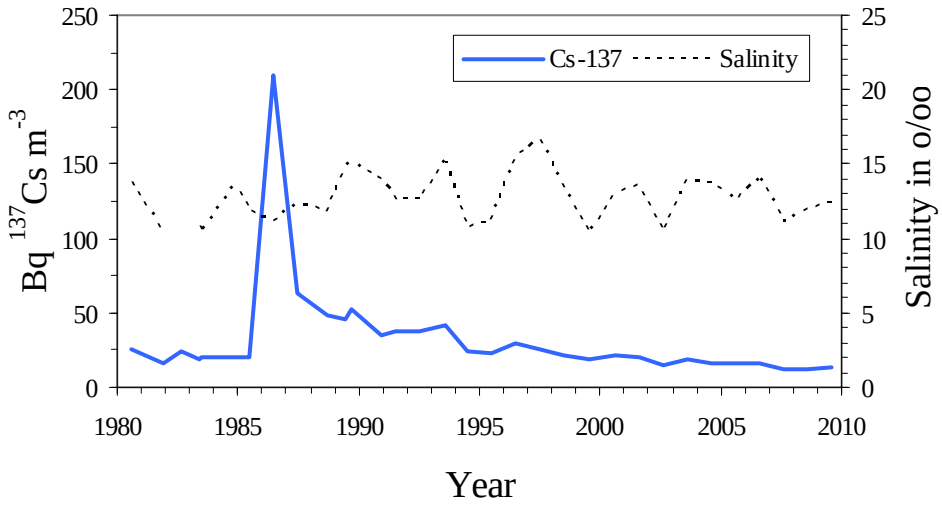

Fig. 4.1. Caesium–137 in seawater collected in Roskilde Fjord 1980 - 2009. (Unit: Bq m^{-3})

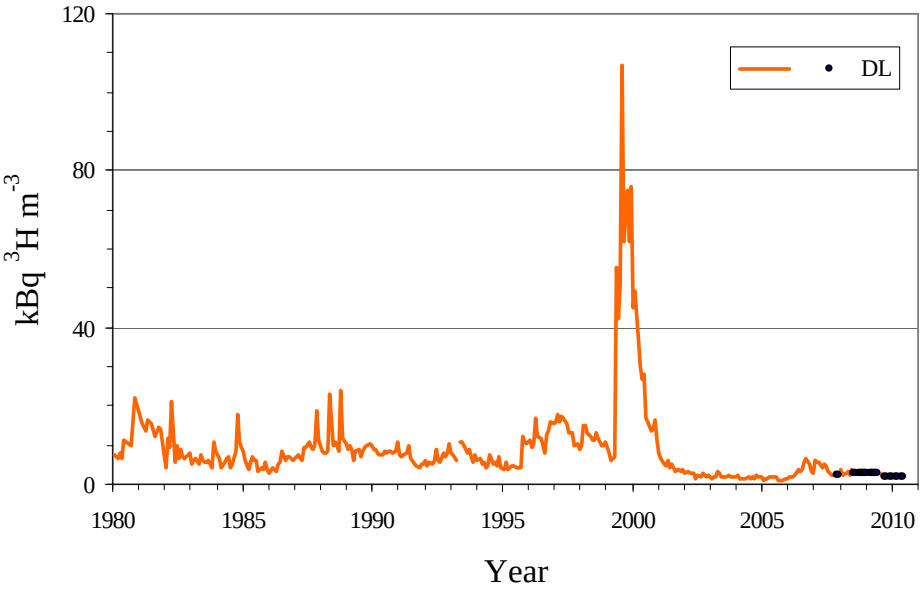

Fig. 4.2. Tritium in seawater collected in Roskilde Fjord 1980 - 2010. (Unit: kBq m^{-3}; DL = detection limit)

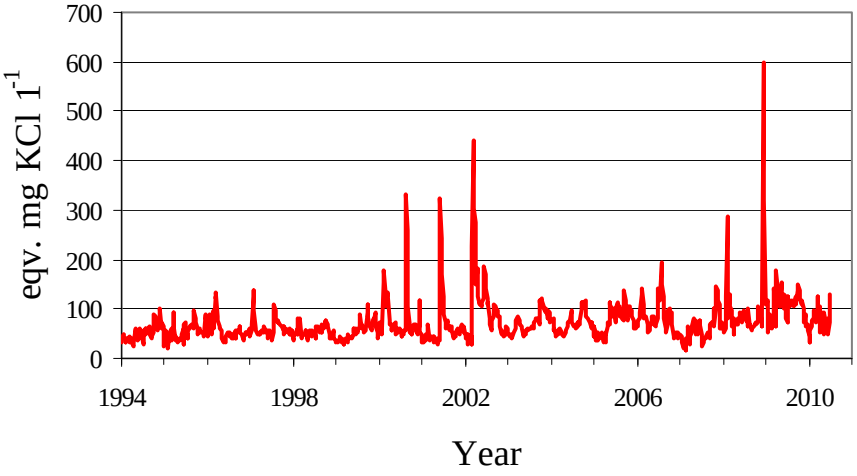

Fig. 7.1. Total-beta radioactivity in waste water collected at Risø 1994 - 2010. (Unit: eqv. mg KCl l^{-1})

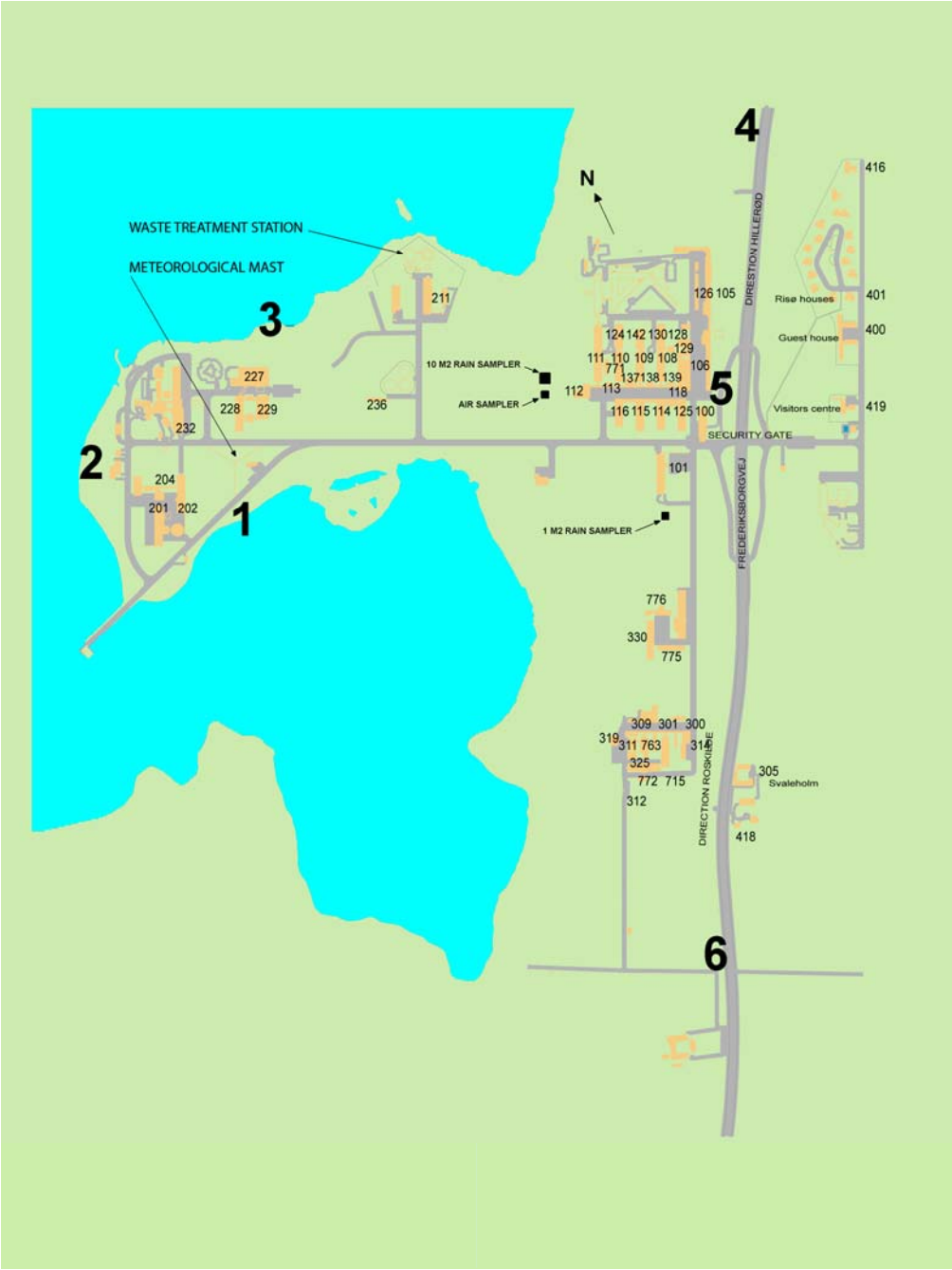

Fig. 8.1. Locations (1-6) for TLD measurements around the border of Risø (cf. Table 8.1).

Fig. 8.2. Locations for measurements of background radiation around Risø in Zones III, IV and V.

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